AVIATION

in

PENNSYLVANIA SCHOOLS

BULLETIN 215

LESTER K. ADE
Superintendent of Public Instruction

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF PUBLIC INSTRUCTION
HARRISBURG, 1939

For I dipt into the future,
far as human eye could see,
Saw the Vision of the world,
and all the wonder that would be;
Saw the heavens fill with commerce,
argosies of magic sails,
Pilots of the purple twilight,
dropping down with costly bales.

(Quotation from "Locksley Hall," published in 1842 by Tennyson.)

FOREWORD

Aviation is an enterprise of universal interest and therefore concerns the educational program of the Commonwealth of Pennsylvania.

Because of its strong appeal to children and youth, it offers an excellent medium for the teaching of many educational activities. Continually before the public, this rapidly growing enterprise is being utilized by alert teachers as a source of interesting materials for instruction in geography, mathematics, history, science, physics, commercial education, and other practical school projects.

The entire field of aviation is, naturally, too extensive for complete treatment in one single publication. The Department of Public Instruction plans to present a series of small pamphlets in which the important aspects of aviation will be presented for school use.

Among the phases of aviation under consideration in this series are the following: the development of aviation, the construction of model-making, flight, navigation and motor instruments, meteorology, and other related topics.

This bulletin has been prepared under the direction of Dr. Paul L. Cressman, Director, Bureau of Instruction, by Frank K. McKlveen, of the Bureau of Aeronautics, in the Commonwealth of Pennsylvania.

LESTER K. ADE
Superintendent of Public Instruction

April, 1939

CONTENTS

		Page
	Introduction	7
I.	Early Experiments	7
II.	Modern Airplanes	14
III.	Modern Airports	19
IV.	Modern Airlines	32
	Conclusion	34
	Bibliography	35

Digitized by the Internet Archive
in 2016

https://archive.org/details/aviationinpennsy00penn

Aviation in Pennsylvania Schools

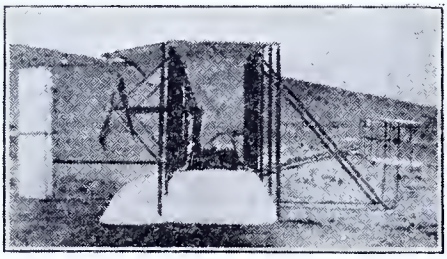
I. EARLY EXPERIMENTS

INTRODUCTION

Swift strides in aviation progress are stirring the imaginations of youth and adults and stimulating our national development toward a new America. Everywhere there is evidence that the next epochal advancement of our civilization will be airward. Symbol of progress, the airplane, with its potentialities of speed and efficiency, has caught the imagination of the nation to such an extent that today the eyes of millions are intently turned toward the sky.

From the fragile box-like crafts of a short generation ago to the sturdy giant-like streamline denizens of our own day, the airplane has reduced the traveling time between nations and conquered barriers that were once the formidable obstacles to speedy international relations. The social implications impinging upon the close relations of peoples of the world by the network of airlines are far-reaching and deeply significant. This modern machine of civilization is bringing the nations of the world into a small neighborhood of adjoining yards and making it possible in the course of a day for one to see peoples of different nationalities in their native states.

1903—Dec. 17—The first flight in a heavier-than-air, motor-driven plane was made by Orville and Wilbur Wright, American citizens, at Kitty Hawk, N. C.



The Wright brothers plane. First successful motor-driven heavier-than-air machine, 1903.

It is interesting to note from an historical standpoint that while reading of the experiments of Otto Lilienthal in Germany, Wilbur Wright, and his brother Orville, became intensely interested in gliding as a sport. Lilienthal's experiments were suddenly ended in 1896, by his death, resulting from an accident due to insufficient control of the equilibrium of his glider. Lilienthal had balanced his machine by shifting the weight of his body. The brothers, believing this method incapable of expansion to meet the requirements of flight, set about to develop a more effective system. They developed a system in which the center of gravity remained constant and the equilibrium was maintained by varying the air pressures on different parts of the machine through adjustments of the angles of

the wings and auxiliary surfaces. This system, patented by them, is now generally known as aileron control.

Although Wilbur and his brother had taken up æronautics merely as a sport, their chief interest soon turned to its more scientific aspects. Having found in their experiments that the existing scientific data was almost altogether untrustworthy, they cast it all aside and began investigations of their own, using methods which avoided many of the errors in the work of their predecessors. In 1901, they set up a small wind tunnel in their work-shop at Dayton, in which they made measurements of the lift and drag of a great number of different shaped aerofoils at angles from zero to forty-five degrees. The results derived from this tunnel so stimulated their interest that often they worked into the early hours of the morning. Measurements also were made to determine the position of the center of pressure on cambered surfaces and to determine the effect on the lift and drag when one surface was placed above another or when one surface followed another.

The First Motor-driven Airplane.—With this mass of data in their possession they thought it now possible to predict from calculation the performance of a flying machine; they thought they could design a machine which would require not over one-half to one-fourth of the power that would have been necessary for any of the earlier proposed machines. Accordingly, in October, 1902, they began the design of a motor-driven aeroplane. When completed, the machine, including the pilot, weighed 750 pounds, and it was propelled by a four-cylinder petrol motor of twelve horsepower. Tested at Kitty Hawk, N. C., on December 17, 1903, the machine carrying a man, made four sustained free flights. The longest of these had a duration of fifty-nine seconds and a speed of thirty miles an hour. This machine is now exhibited in the Science museum at South Kensington, London.

Experiments were continued in 1904, but it was not until September, 1905, that they learned to avoid the "tail-spin" in making short turns. The flights then rapidly increased in length, and on October 5, Wilbur Wright flew for thirty-eight minutes over a small circular course, covering a distance of twenty-four miles. Believing the machine now to be developed to a stage of practical usefulness, the Wright brothers spent several years in finding a market for the invention. Wilbur Wright went to Europe in 1908 to make the tests required in the sale of the French rights to a syndicate. While there, his flights at Le Mans and Pau, France, and at Rome, attracted world-wide attention, and the kings of England, Spain, and Italy went to see him. In recognition of his pioneer work he received many honors and medals in European countries and in America.

During the last three years of his life he served as president of the Wright Company, which had taken over the patent rights for America. Much of this time he devoted to upholding the Wright aeroplane patents in law courts of America and Europe. He died of typhoid fever, at Dayton, Ohio, on May 30, 1912.

Underwood & Underwood
ORVILLE WRIGHT. First man to fly in a motor-driven heavier-than-air machine, 1903.

Underwood & Underwood
WILBUR WRIGHT, co-inventor, with his brother, of the first successful airplane, 1903.

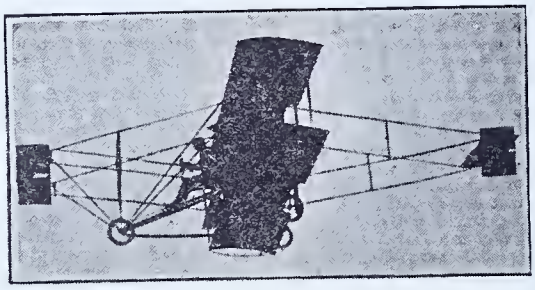
WRIGHT, ORVILLE (1871-)

American inventor, was born at Dayton, Ohio, on August 19, 1871. He early became associated with his brother, Wilbur, in the bicycle repair business, and from the first shared his interest in mechanical flight. Shop experiments led to the development of a power-driven heavier-than-air machine which was piloted by Orville Wright, on its first successful flight made on December 17, 1903, at Kitty Hawk, N. C. Further experiments led to the development of an aeroplane which established a new record on September 12, 1908, by remaining in the air one hour and fifteen minutes. An accident on September 17, terminated his experiments for that year, but on July 27 and 30, 1909, his demonstrations at Ft. Meyer, Va., satisfied the tests, and secured the acceptance of his machine by the U. S. Government. Numerous demonstrations made in Europe during 1908 and 1909, caused many honors to be bestowed on the two brothers. In December 1928, the 25th anniversary of the first successful flight was celebrated at Kitty Hawk.

WRIGHT, WILBUR (1867-1912)

American inventor, son of Milton and Susan Catherine Koerner Wright, was born near Millville, Ind., on April 16, 1867. When Wilbur Wright was one month old his father was elected editor of the official organ of the Church of the United Brethren in Christ, necessitating moving his family to Dayton, Ohio; and eight years later he was elected bishop of that denomination requiring other changes of residence. As a result, Wilbur Wright received his education in the public schools of Dayton, Ohio, Richmond, Indiana, and Cedar Rapids, Iowa. Just when he was expecting to enter college, an accident, while playing in a game of hockey, disabled him for some six or eight years for active work. These years of poor health he devoted to the care of his invalid mother and to assisting his father in legal matters connected with the church. In 1890, he joined his brother, Orville, who was publishing a small weekly newspaper.

The picture below shows the airplane that was used by Glenn Curtiss, in which he won the Gordon Bennett Cup for America, at Rheims, France.



Glenn Curtiss' Gordon Bennett cup winner, Rheims, 1909.

Curtiss, Glenn Hammond, American aviator, born Hammondsport, N. Y., May 21, 1878; died July 23, 1930. When a newsboy he was interested in mechanics. In 1906, he established the world's motorcycle speed record per mile, twenty-six and two-fifths seconds. He was director of the Aerial Experiment Association of America 1907-1909; established flying schools in 1909-1919; introduced the flying boat to Brazil, Russia, Austria, Italy, and Germany in 1913-1914. He won many prizes; the Scientific American Cup in an aeroplane competition in 1908; the international Cup in the aeroplane contest at Rheims, in 1909; the $10,000 New York World prize award for a record-breaking flight from Albany to New York in 1910; a medal of the Smithsonian Institute in 1913. Besides making many flights both in the United States and abroad, he was actively engaged in the commercial side of aviation, being secretary and treasurer of the Curtiss Exhibition Company, of New York, and president of the Curtiss Aeroplane Company, at Hammondsport, N. Y. He developed the "Wasp" (the holder of the world's records for speed, climb, and altitude) and other types of aeroplanes, flying boat types, etc., many types of motors, lifeboats, etc.

At Rheims, Mr. Curtiss won the Grand Prix de la Vitesse, by a flight of thirty kilometers in twenty-three minutes and twenty-nine seconds; and the Gordon Bennet Trophy, by flying twenty kilometers in fifteen minutes and fifty seconds, at a speed of forty-six and a half miles an hour.

The following is an expression of Gabriel d'Annunzio, the Italian poet and dramatist, after he had been given his first airplane ride by Mr. Curtiss: "Until now I have not really lived. Life on the earth is a creeping, crawling business. It is in the air that one feels the glory of being a man and of conquering the elements. Then the exquisite smoothness of the motion and the joy of gliding swiftly through space—it is wonderful! Can't I express it in poetry? I must try."

It is suggested that it will be found most interesting if one will read of the Gordon Bennet Cup Race held at Rheims, France. An interesting treatise of this can be found in the publication of "Country Life in America," of November 1909, page 27, which should be available in all public libraries.

Bleriot crossing the English Channel, 1909.

Photo from Herbert Photos, Inc.
LOUIS BLERIOT, France, who flew the English Channel in 1909.

AN OUTLOOK OF AUGUST 7, 1909

The successful and dramatic flight of Monsieur Louis Bleriot, in his monoplane across the English Channel from Calais to Dover on Sunday morning of last week, if it does not mark an epoch in the art and science of traveling through the air, certainly fixes public attention throughout the civilized world upon the air-ship as a practical passenger conveyance to a degree which no other event in the history of aeronautics has succeeded in doing. M. Bleriot is a graduate of the French Polytechnique, one of the leading engineering schools of the world, and has for many years been devoting his time and resources to the study of aviation, with, however, little practical

success up to the day of his startling voyage from France to England. The English Channel, between Calais and Dover, is twenty-one miles in width. Since the days of the Romans it has been famous in literature and history as one of the most terrifying parts of the ocean, on the globe. The choppy seas, the fogs, the variable and often fierce gales, the chalk cliffs of the French and English coasts, the threatening sand-bars, and the crowded traffic, with inevitable danger of collisions, have made it the terror of travelers and the dread of navigators for many generations. It has been to the ocean traveler what the St. Bernard Pass used to be to the foot and horse passengers crossing the Alps in the Middle Ages—an obstacle which the timid traveler rarely attacked without commending his soul to God and his body to the protecting care of expert lifesavers. The difficulty of its passage has been one of England's chief fortresses of protection against invasion from the Continent of Europe, and Englishmen have refused, unreasonably we think, to attempt to build a railway tunnel under the Channel between Calais and Dover, in the belief that this would take away from the British Isles one of their greatest natural protections against a foreign foe. One of the Outlook staff, at the conclusion of a voyage of over three months from Melbourne, Australia, once spent five days in the English Channel upon a sailing vessel, buffeted by the waves, hampered by adverse winds, enveloped in fogs, and threatened with the constant danger of collision with passing vessels. Having taken on a pilot at Falmouth, it was five days before the ship succeeded in entering the mouth of the Thames. And this was hardly twenty-five years ago. One who knows the English Channel under these circumstances, and who is more or less familiar with the record of shipwrecks and collisions from the time of the destruction of the Spanish Armada to this day, must be instantly impressed with the revolution in navigation which Bleriot's successful crossing of the Channel presages. He made the crossing of twenty-one miles in twenty-three minutes, rising from Calais at half-past four in the morning and landing in a meadow near Dover at fifty-three minutes past four. His eventful journey was made in response to the offer of a prize by the London Daily Mail, of five thousand dollars, to the first man who should successfully cross the Channel between sunrise and sunset in a flying machine heavier than air.

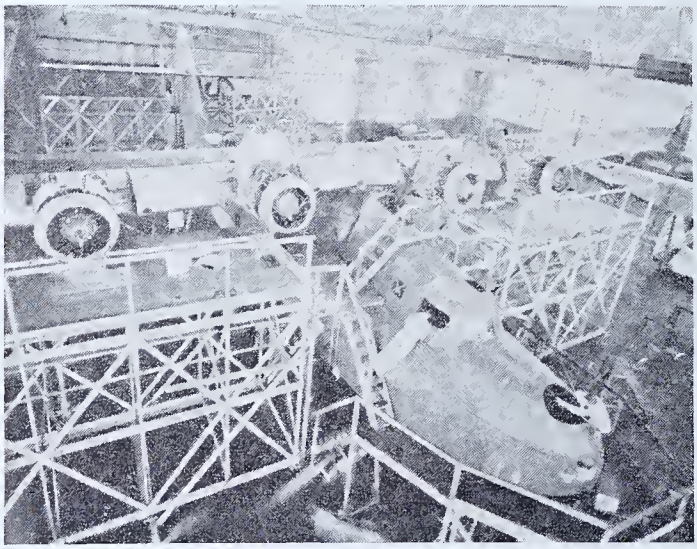
M. Bleriot's Own Story—Unquestionably it required great technical skill and great personal courage on the part of M. Bleriot to make his dramatic journey. His account of his experience, contributed to the London Mail, and specially cabled to the New York Times, is an interesting illustration of the fact that masculine daring and physical strength are not at all incompatible, in the French, with a certain theatrical love of display and childlike intimacy of expression at which the Anglo-Saxon is inclined to smile. We quote:

"As soon as I am over the cliff I reduce speed. There is now no need to force the engine. I begin with my flight steady and sure toward the coast of England. I have no apprehensions, no sensa-

tions—pas du tout—not at all. The escopette (a French torpedo boat assigned by the Government to follow M. Bleriot as a precaution in case of accident) has seen me. She is driving ahead at full speed. She makes perhaps twenty-six miles an hour. What matters it? I am making at least forty-two miles an hour. . . . Ten minutes are gone. I have passed the destroyer, and I turn my head to see whether I am proceeding in the right direction. I am amazed. There is nothing to be seen—neither the torpedo-boat destroyer, nor France, nor England. I am alone. I can see nothing at all. . . . I fly westward and reach Shakespeare Cliff. I see an opening in the cliff. . . . Once more I turn my airplane, and, describing a half-circle, I enter the opening and find myself again over dry land. . . . At once I stop my motor. . . . In two or three seconds I am safe upon your shore. Soldiers in khaki run up, and policemen. Two of my compatriots are on the spot. They kiss my cheeks. The conclusion of my flight overwhelms me. Thus ended my flight across the Channel, a flight which could easily be done again. Shall I do it? I think not. I have promised my wife that after a race for which I have already entered I will fly no more."

M. Bleriot's literary style, although quite unlike that of an American or British scientific aeronaut, does not detract in the slightest from the glory of his achievement; it simply adds to its picturesqueness. It may also be true that his contributions as a scientific investigator to the art of air travel are not as complete or effective as those of the Wright brothers in this country or Count Zeppelin in Germany, but this does not alter their historic character. Nor will it do to say, because of the flimsy character and small carrying capacity of Bleriot's machine, that air-ships will never cross the Channel with freight and passengers. Robert Fulton's voyage from New York to Albany, at the rate of five miles an hour, in a steamboat that belched fire and smoke, to the terror of the inhabitants along the shore, was neither as scientific nor as majestic as the transatlantic trip of a Mauretania. But as Fulton's journey was the forerunner of circumnavigation of the globe by steam power, it is not unreasonable to suppose that Bleriot's trip from Calais to Dover is the predecessor in the years to come of numberless voyages of airships from continent to continent.

II. MODERN AIRPLANES



None but skilled mechanics are allowed to work on aircraft, such as that illustrated here, where extreme accuracy and care are necessary. (Courtesy of the Glenn L. Martin Co.)

One can very readily discern from a standpoint of the above picture that it shows the interior of a modern aircraft factory. From a closer study of the picture, one can very readily determine that a huge flying boat under construction is being completed. Such flying boats as these are manufactured by the Glenn L. Martin Company, Baltimore, Maryland. The one shown here, being a four-motored flying boat, is comparable in design to that of the "China Clipper."

On a trip through this aircraft factory, we will note the superior material, high-grade equipment, and first-class workmanship. The aircraft manufacturer is conscious of the necessity of accuracy in the manufacturing processes, also in maintaining high standards, in order to insure efficiency and safety in the construction of airplanes.

Rigid inspection based upon static testing of completed structures insures against faulty workmanship. Airplanes now may be more easily maintained, which is due to a great extent in the use of metal. Fires in the air have become practically unknown and structural failures are almost an unheard of occurrence. All of which goes to prove the high grade of workmanship, material, thought, and planning which is incorporated in the manufacture of modern aircraft.

Question: What does a glance at the picture above mean to you?

A glance at this picture should certainly touch the imagination of all. It would appear to bring a picture to us of one of the greatest metropolises in the world—the ultimate in construction, massiveness, and area—all conquered by the ingeniousness of man. How little and insignificant it is as viewed from this major airliner that is winging its way over the nation and universe, creating an industry destined to take its place among the major industries of the world.

Pearl Harbor. Base of operation used by P. A. A.

The China Clipper Docking

Regardless of where one may wish to go today, interconnecting schedules of the Airline Companies of the world make round-the-world schedules possible now by air.

It will be interesting to carefully note the airway map of Europe, Africa, Asia, and Australia, of North and South America, and of the United States.* Various routes and the cities on these routes can be very readily followed by referring to these maps.

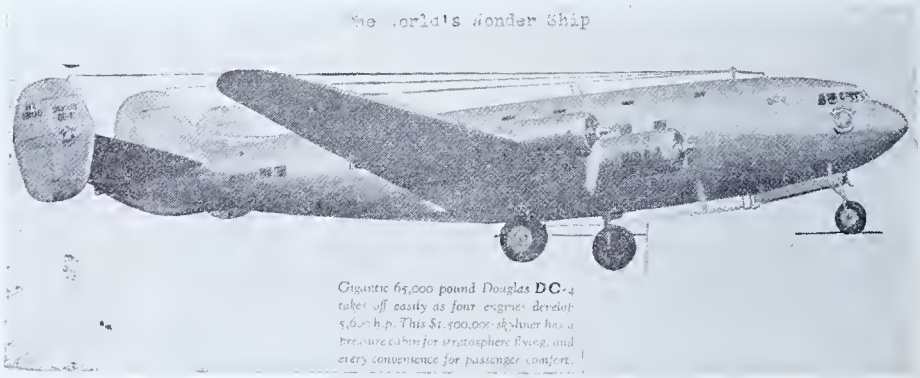
The "China Clipper," docking at Pearl Harbor after her maiden flight from the mainland. This flying boat was made for scheduled passenger service between California and the Far East, and regular schedule was established on November 22, 1935, climaxing a period of four years of preparation.

On the maiden flight, it carried 42,000 pieces of mail, reaching Honolulu, a distance of 2,404 miles in twenty-one hours, thirty-nine minutes. Scheduled passenger service began operation October 21, 1936.

The total flying distance from San Francisco to China is about 8,500 miles; Honolulu to Midway Island, 1,320; Midway to Wake Island, 1,248; Wake to Guam, 1,500; Guam to Manila, 1,600; and Manila to China, 650 miles.

The "Clipper," which is twenty-five and one-half tons gross weight, is constructed to accommodate eighteen passengers in berths, a crew of six, a ton of mail, a ton of express, fuel for 2,400 miles, and capacity for an excess of an 800 additional miles if needed. The plane is equipped with every modern device and convenience.

THE WORLD'S WONDER SHIP



Gigantic 65,000-pound Douglas DC-4 takes off easily as four engines develop 5,600 h.p. This $1,500,000 skyliner has a pressure cabin for stratosphere flying, and every convenience for passenger comfort

An examination of the ship as pictured above, will disclose a major departure from the conventional type airplane, as this type of airplane which is known as Douglas DC-4, uses and incorporates a tricycle landing gear in effecting a landing in comparison to the conventional plane which has a tail wheel.

On January 7, 1939, the Douglas DC-4, the first four-motored commercial land transport manufactured in the United States, was

successfully test-flown at the Douglas factory in Santa Monica, California.

One outstanding feature in the construction of this plane is the fact that all motors are accessible during flight in case that a minor adjustment may be made. The ship includes over and above the regular features of comfort and convenience of air travel, the use of a private section in the rear of the ship, such as a small apartment including a living room and other private conveniences. The construction of this ship was made possible through the combined effort and financing of the five major airlines, operating in the United States.

The cost of this ship was $1,500,000, and it is believed that these ships will be pressed into service in the very near future.

June 7, 1938, marks the day that Douglas Aircraft Company's largest project to date, the four-engined DC-4, took to the air, flew over Los Angeles, landed at the Municipal Airport, and then returned to its home base at Santa Monica's Clover Field, its initial flight tests satisfactorily completed after ninety minutes in the air.

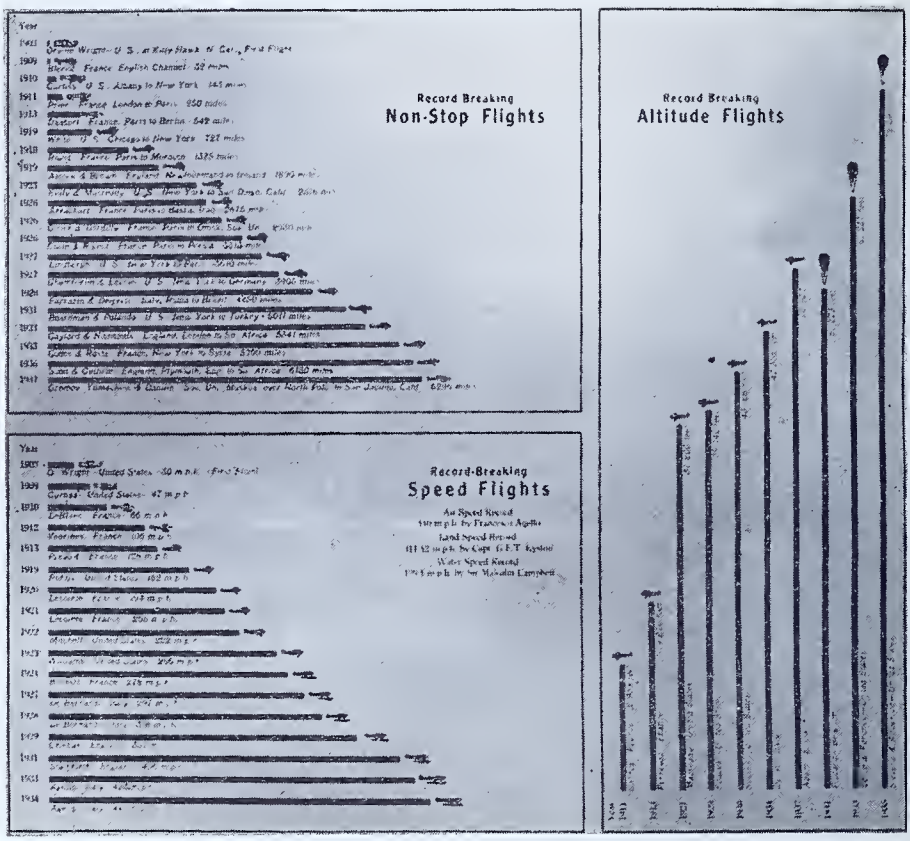
With test pilot at the controls, the four P. & W. Twin Hornet engines lifted the 65,000-pound transport easily, bringing to a successful conclusion two years of construction and engineering work inaugurated by a combination of air transport operators—United, Eastern, TWA, Pan American, American—working in close collaboration with officials of the Douglas Company.

Featuring the initial use on a modern transport of a fully retractable tricycle landing gear, the DC-4 provides accommodations for forty-two passengers, a crew of five; for night operations, berths for thirty passengers are available. Unmistakaby Douglas, the transport measures 138 feet three inches in span, ninety-seven feet seven inches in length and twenty-four feet six inches in height. Its front wheel is designed to permit smoother and safer landings and to provide additional comfort for passengers inasmuch as it allows take-offs and landings in a horizontal plane.

Intended for transcontinental operations, the transport's compartments will consist of one for the pilots, another for the radio operator, six for cargo and baggage, two for dressing rooms, one for the galley, another for a private drawing room with a dressing room, and the main passenger compartment.

Undergoing extensive static tests before it was flown, the DC-4 performed so well in the air that it is considered one of the most efficient ever developed.

Third and most powerful in a series of twin-row engines developed by Pratt & Whitney Aircraft, each of the new Twin Hornets powering DC-4 has a take-off rating of 1400 horse power at 2500 revolutions per minute, using ninety-five octane fuel; 1200 horse power using eighty-seven octane fuel.



A study of the above chart of record-breaking non-stop flights, record-breaking altitude flights and record-breaking speed-flights, are shown from the first flight made by the Wright Brothers, December 17, 1903, and the remarkable advancements that have been made as to altitude and speed from the year 1903 to the year 1937.

It is very interesting to note that at Buffalo, New York, during the month of November, 1938, that tests of planes made for the Army have attained speed upward and over 600 miles an hour in dives, which speed will probably be even greater in the future.

III. MODERN AIRPORTS

Harrisburg Airport.

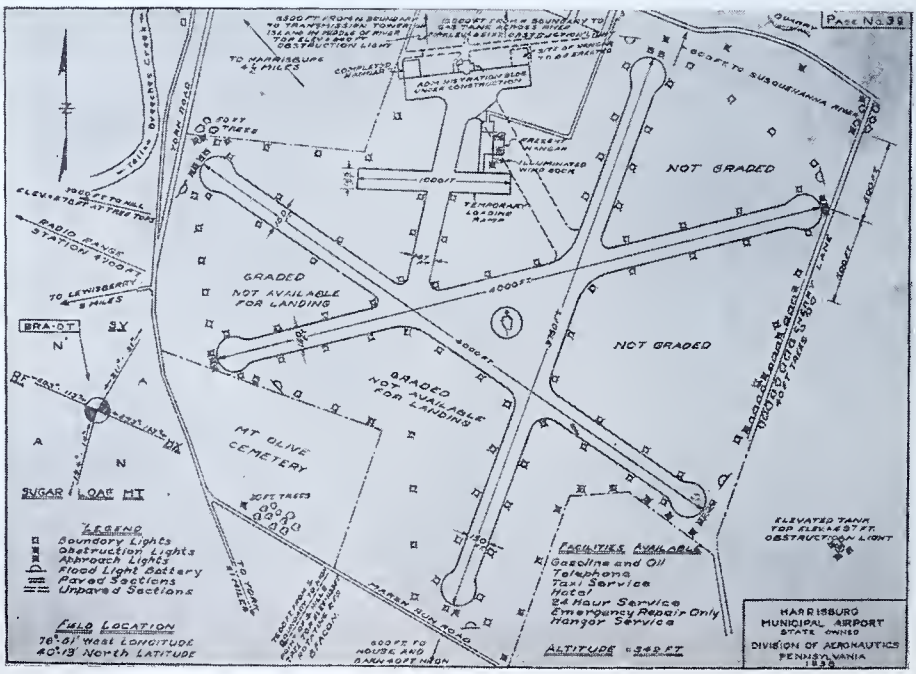
In Pennsylvania we have over 118 fields and approximately 1,000 pilots of various classification. In the United States there are approximately 2,374 fields, of which 718 have various types of night landing equipment, also there are more than 11,000 airplanes.

Since we are particularly interested in the development of aeronautics in Pennsylvania as it relates to airports and their construction, we are giving specific attention to one of the most modern airports that has been developed and built in the United States, and which is located at Harrisburg, the Capital of Pennsylvania.

This airport incorporates the latest facilities, such as modern hard surfaced runways, stationary turn tables, well-drained runways, and the most up-to-date field lighting, such as boundary lights, approach lights, obstruction lights, and flood lights.

The program calls for the development of an instrument approach system. There is also constructed on the airport one of the most modern Administration buildings and hangars. The Administration Building is equipped with all modern conveniences and facilities for use by the Airlines which use Harrisburg as a terminal. The building also includes rooms for the dispatching of air mail for use by the Post Office Department, weather stations, Civil Aeronautics Authority operations, and is equipped with one of the most modern control towers of the latest constructed airports in the United States.

It is advisable, that if an opportunity should present itself, that one come directly to Harrisburg and make a study of this very modern airport.



Modern airport plan.

The airport plan of the Harrisburg Airport is shown so that one can very readily appreciate what a design of a modern airport should be. A legend on the print will show the various conveniences that one may find at the airport as well as a list of the facilities available.

The runways are 4,000 feet and 3,750 feet respectively, in length, and the relative position of these runways are shown by a study of the print. A meridian marker on the upper left hand corner of the print will enable one to discern the various directions of the runways, which should be given careful consideration at such time as an airport is being laid out and designed.

The print also shows the location and nature of a radio range station, the location of the Administration Building and hangars, as well as the placing of the lighting around the field.

AIRPORTS AND AIRWAYS IN PENNSYLVANIA

The map above is that of the airports and airways in the State of Pennsylvania. It may be possible that one of these airways may even run over your home. A study of the course of these airways will definitely tell whether or not one of the major airlines cross your home.

Five major airlines operate in and about the State of Pennsylvania, and a study of the map will disclose the number of every airways in the State. For instance, if we will look a little to the east of Lancaster, we will note that this is airways one, which is operated over by Transcontinental and Western Air on their Newark-Los Angeles run; there are two stops at present in Pennsylvania on this airways at Harrisburg and Pittsburgh. It is hoped that Philadelphia will soon be possible as a terminal on this route, and as soon as the airport construction program on the Philadelphia Airport is complete, an endeavor will be made to have the airlines stop at Philadelphia instead of Camden.

A further study of the map will disclose that airways seven of the State of Pennsylvania can be seen by looking a little to the northeast of Towanda. This airways is operated over by American Airlines. The flight originates at Newark and crosses Pennsylvania a little southeast of Stroudsburg and continues up over the Poconos to Wilkes-Barre. American Airlines stop at Wilkes-Barre and the flight continues on in a northwest direction to Elmira, New York, and from there to Buffalo.

Airways two in the State of Pennsylvania can be seen by checking on the map near Buckstown, Pa., east, southeast of Pittsburgh about seventy miles. This airways is operated over from Pittsburgh to Washington, D. C. by Pennsylvania Central Airlines. They also operate over Pennsylvania on a flight originating in Washington, D. C. via Harrisburg, stopping at Williamsport, then to Elmira and Buffalo.

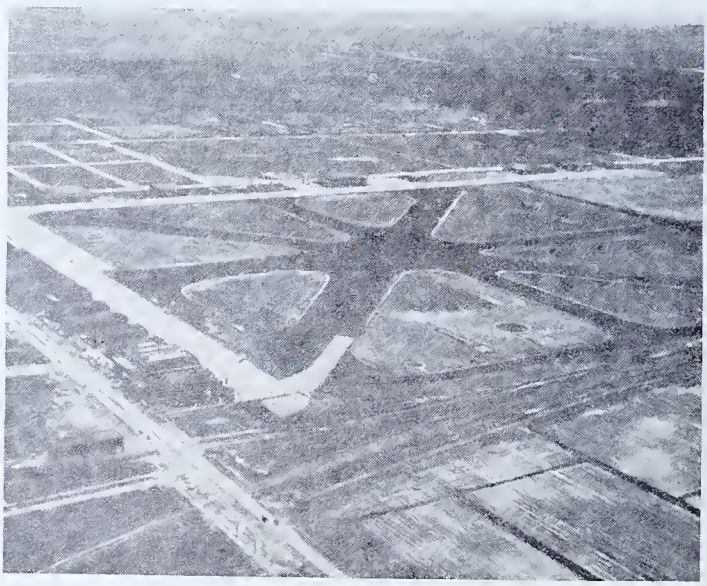
Airways ten operated over by Pennsylvania Central Airlines originates in Pittsburgh to Erie.

Airways nineteen in the State of Pennsylvania can be identified by looking a little to the east of Sunbury, Pa. This airways is operated over by United Airlines on its Newark-Chicago run. It enters Pennsylvania a little to the north of Allentown and leaves the State of Pennsylvania around Sharon. There is at this time a construction of an airways from Allentown to Philadelphia, which will be used by United Airlines.

To one interested in the advancement and the relation of Pennsylvania to aviation, it is gratifying to know that we stand out as one of the most advanced states in aeronautics of the forty-eight states.

Conveniences made possible by this airport and airways map are that it shows the geographical location of all of the licensed airports in Pennsylvania, references them with relation to the closest city, shows the altitudes of all of the fields, shows coordinates at every thirty minutes of longitude and latitude, shows lines of magnetical variation, the important rivers and the location of the radio range stations in Pennsylvania, as well as giving their frequency, identification signal and call letters.

The map also has a legend of the various airways, both State and Federal, has an airport classification and a scale of statute miles, as well as a compass rose for plotting courses.



The Chicago Municipal Airport here illustrated is one of the major centers for air travel in the United States. Airports and other aids to air transport are to aviation what roads are to automobiles. (Courtesy United Air Line.)

DEVELOPMENT OF A MODERN AIRPORT ALONG THE NATIONAL AIRWAYS

As one journeys along the modern airways operated by the major airlines, the familiar figure of airports such as shown here are seen.

The above airport is that of the Chicago Municipal Airport, which, when completed, will be one of the largest airports in the world, and will be approximately one-mile square.

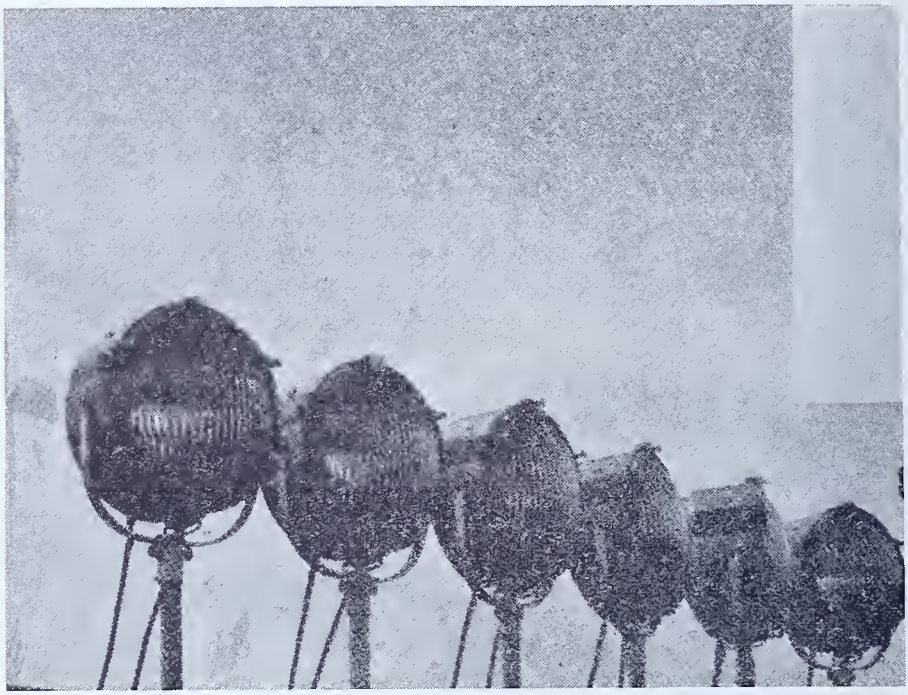
At the present writing, a railroad runs directly through the field, however, the program calls for the removal of this railroad. The airport at that time will then be completed with hard surfaced runways and other modern airport conveniences.

Above: Seen at every airport is the ever-present wind sock, which indicates the direction of the wind.

The wind cone which is pictured above is a very familiar sight which will be seen at every airport. During the day, wind cones can be very readily seen, however, at night, the cones are lighted, as shown above by the light brackets above the cone.

The wind cone serves a very specific purpose to the pilots, as it tells the exact direction from which the wind is blowing, and this information is necessary, for a pilot must land and take off against the wind. However, if there is little or no wind blowing, the pilot can take off in any direction that may be available from the standpoint of the area of the airport.

AIRPORT FLOODLIGHTS



Bank of airport floodlights.

Another very familiar sight along an airways, and specifically at an airport, are banks of floodlights. These lights, which vary as to candle power, appear at the ends of runways and light the area that the pilot is to land on.

To a great extent today, landings are made on specific runways, and floodlights are to be found at the ends of these runways. The floodlights direct the ray of light in the direction in which a pilot should land. In some instances, however, where there is no hard surfacing, these lights will be placed so that the pilot will be landing into the most prevailing wind, and are given consideration in their placing with reference to prevailing wind direction.

WIND-T-INDICATOR

This wind indicator is in the shape of a T and moves with the wind as a guide to airmen about to land. At night it is lighted.

MODERN AIRLINE IN PENNSYLVANIA

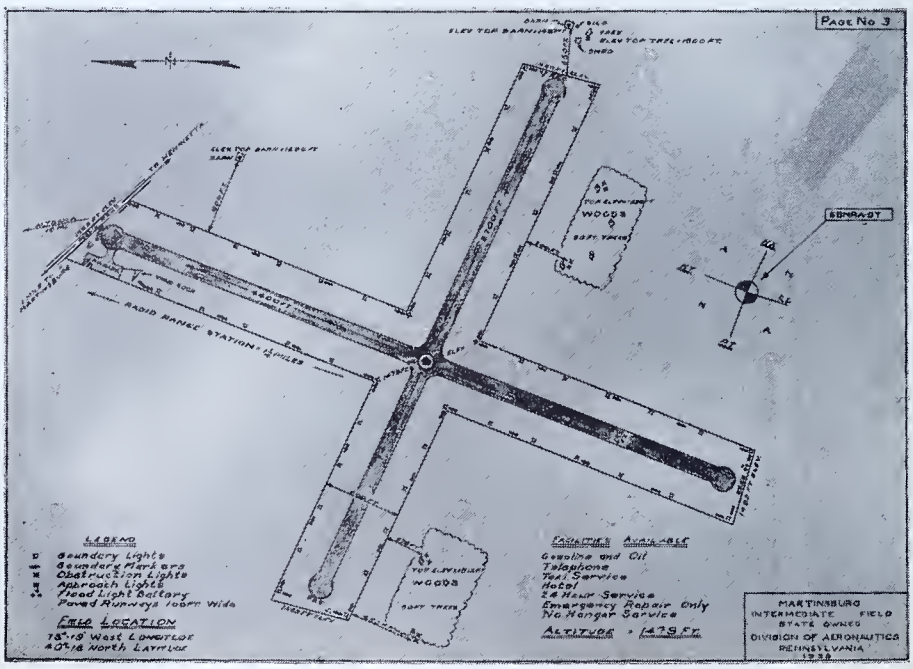
The Wind-T-Indicator is a more modern device for indicating the wind direction than that of the wind cone.

From a standpoint of the picture above, one will note the light bulbs on the top of the T. At night, the T is lighted so that the pilot can determine more easily what the exact wind direction may be from a visual indication that is determined by looking at the wind T. The cross of the T is always in the direction from which the wind is coming.

It might be helpful that one visit a modern airport and make a more complete study of these modern devices.

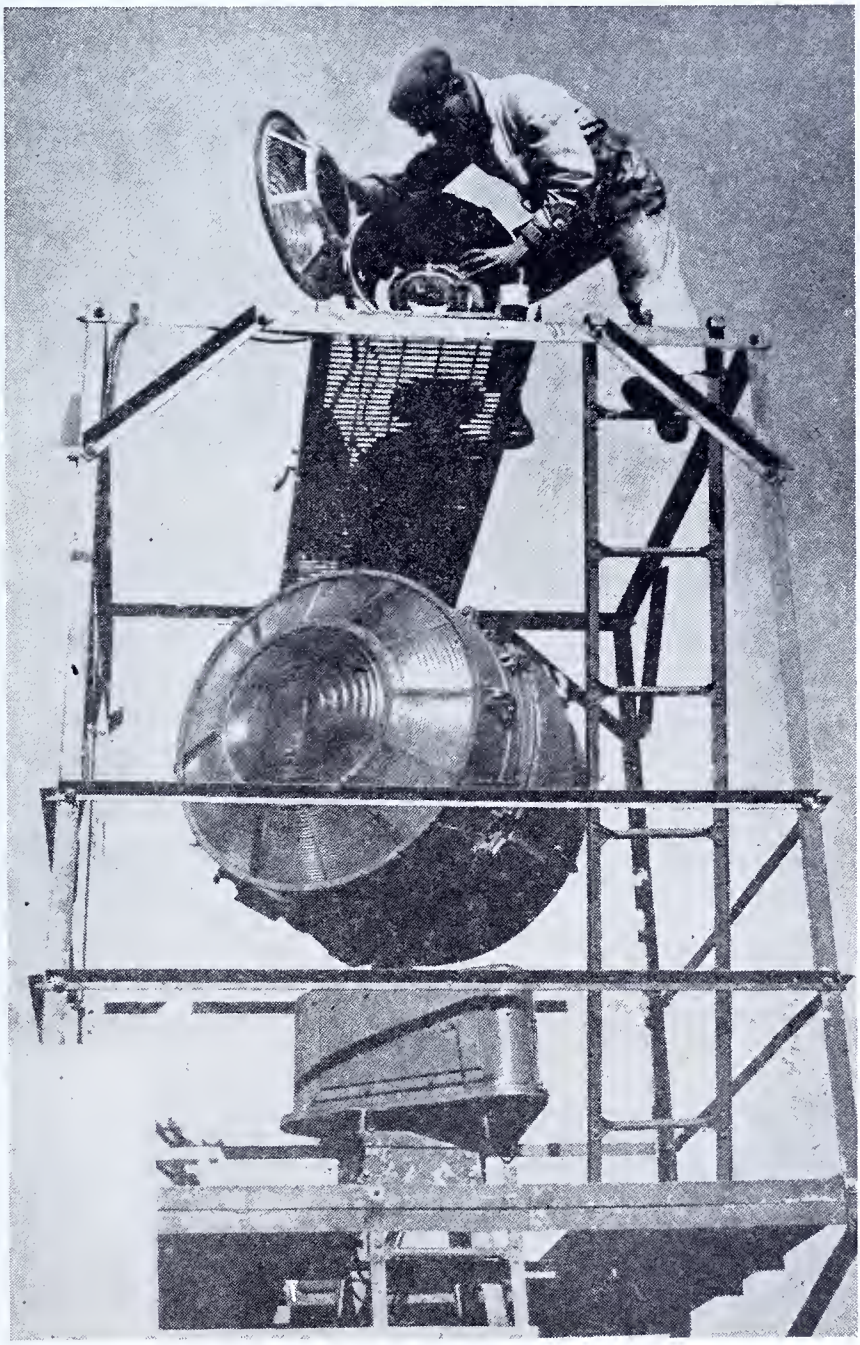
The on-course beacon is a very familiar sight to be seen along the Federal and state airways. The one pictured is that of a double end type, revolving three times per minute and giving out six flashes per minute, which is a standard amount of flashes per minute of the on-course beacon, which light is one and one-half degrees to the horizon.

It will be noted that the workman on the top of the structure is replacing a bulb in the on-course light. These on-course lights flash out various colors. If the beacon happens to be placed nearby or on an airport, it will be green. However, if it is a beacon on the airways alone, it will flash out a red signal. The on-course light is pointed into the exact direction of the next on-course beacon on the airways. The revolving beacon varies in candle power from 500,000 to 1,000,000, and is placed at ten-mile intervals along the



Martinsburg State Airport.

ON COURSE BEACONS



airways. On clear nights they can be very readily discerned for a distance of forty or more miles. The Commonwealth of Pennsylvania has been very instrumental in the reconditioning and the realignment of these on-course beacons on the Federal airways of Pennsylvania.

The Martinsburg State Airport, located eighteen miles south of Altoona, represents one of the largest and most complete intermediate fields along any airways. It consists of hard surfaced runways adequate in length and width, complete field lighting, flood lighting, approach lights, two-way radio facilities, as well as being properly marked from a standpoint of obstructions when the field is used at night.

This is one of the most complete fields in Pennsylvania and is midway between Pittsburgh and Harrisburg on Transcontinental and Western Air's route from Newark to Chicago—Chicago to Newark. This field was constructed by the Division of Aeronautics, Department of Revenues, and can be said to be one of the most outstanding fields in Pennsylvania.

A study of the airport map will disclose many interesting facts about this airport such as field location, facilities available, and a legend of airport aids to safe air navigation and landings. Even the altitude of the field is shown which is very important to airmen.

PENNSYLVANIA OPENS NATION'S FIRST STATE RADIO NAVIGATION SYSTEM

Program Includes Simultaneous Radio Range Beacons, Localizers, and Markers for Area Once Most Dangerous in United States

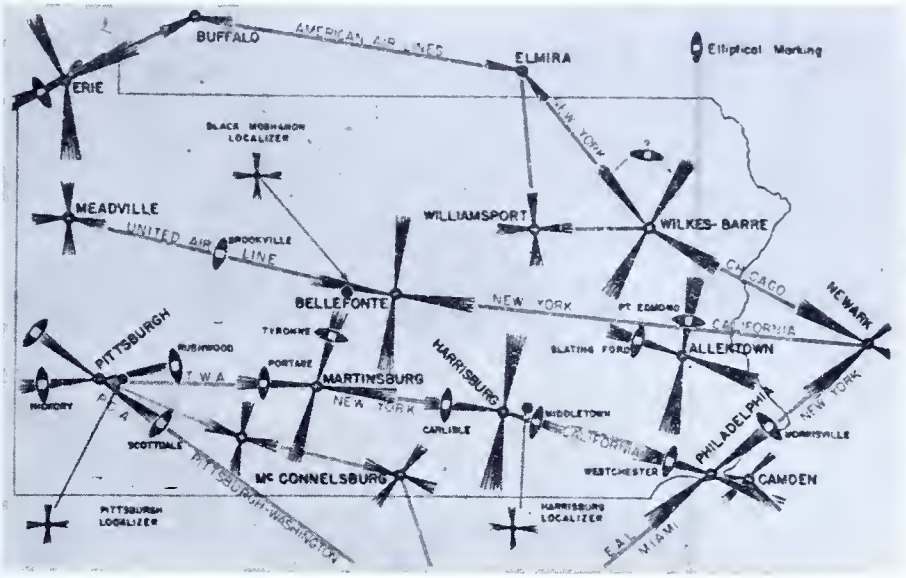
---

RADIO AIDS TO AIR NAVIGATION—PENNSYLVANIA

Without a study and complete understanding of the above map, it seems to consist of a series of markings which are of little or no significance unless they are fully understood. To the airman, it is essential that he become fully acquainted with these facilities and understand them thoroughly. Possibly to you they hold little significance, yet they are most interesting and contain a wealth of knowledge and information.

The figures which represent themselves as fans are really on-course positions on the airways. The on-course positions are made possible by the interlocking of radio signals, and the on-course position is to the airmen what the road and signs along the highways are to

Pennsylvania Radio Aids in Operation



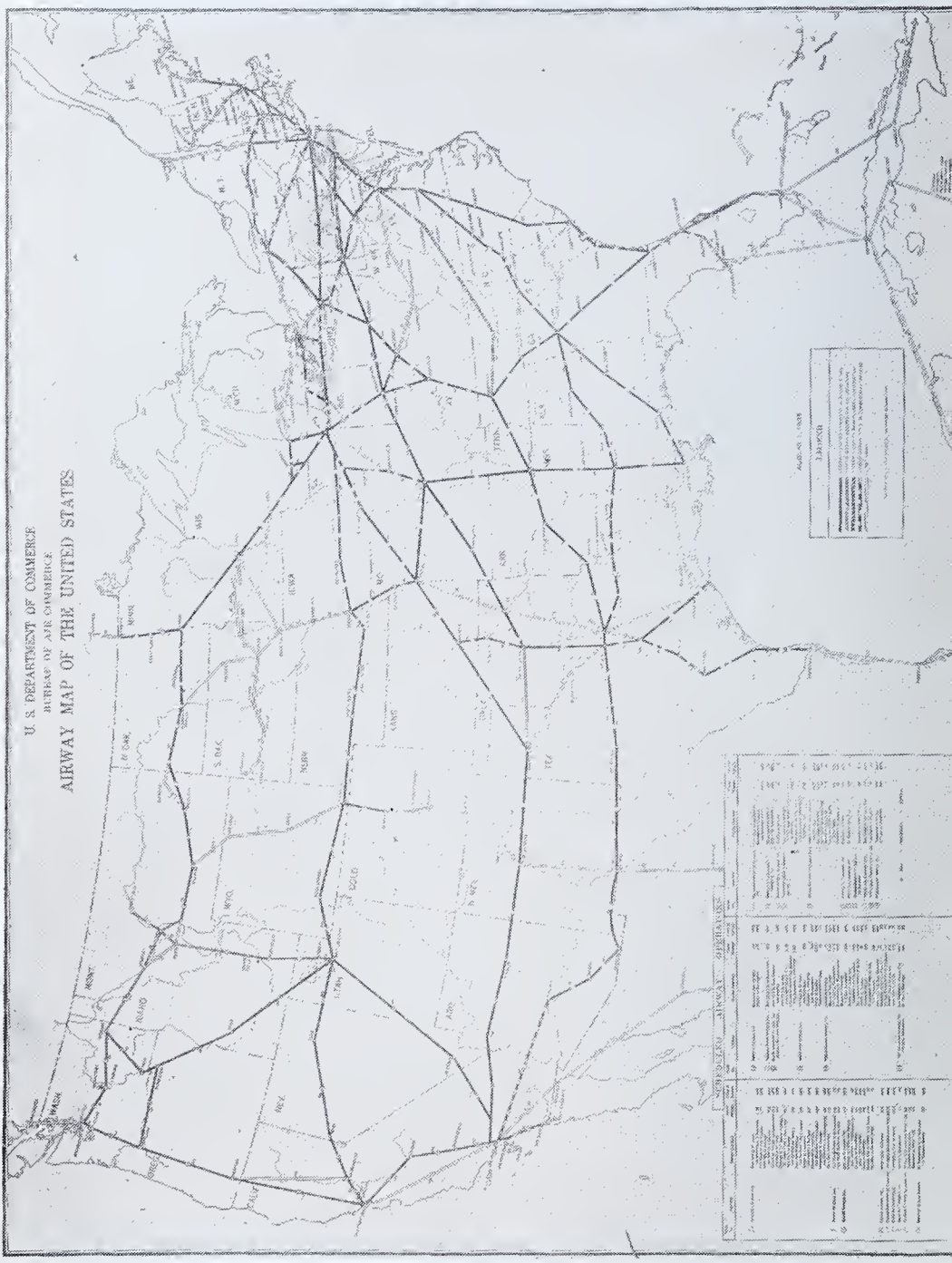
Map showing various units in the ultra-modern radio navigation system built by the division of aeronautics of the Pennsylvania Department of Revenue. Stations outside state boundaries were built by the U. S. Government.

the automobile driver. These on-course positions are maintained and held in definite channels and are as well located and prescribed to the airmen as the highway is to the automobile driver.

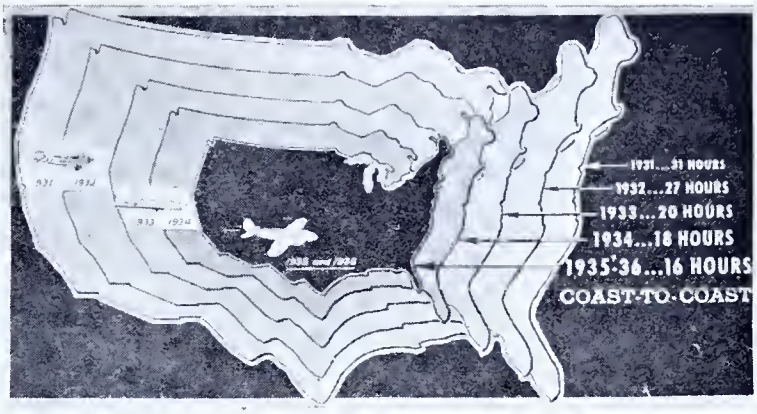
The elliptical marking is what is known as a definite fix along an airways and it enables a pilot when passing through one of these fixes to be definitely sure of his geographical location and position on these airways.

It is recommended that for a further study of these radio aids in Pennsylvania that a booklet called "Aeronautical Radio" be secured from the Civil Aeronautics Authority in Washington, D. C., which very clearly and completely sets forth a simple discussion of all of the various radio aids that are now in use along the Federal airways and which radio aids in the State of Pennsylvania form a part of this national network.

In the United States alone, we have over twenty-eight scheduled air lines operating on regular schedule and can be seen by checking on the airway map of United States. Significant also is the fact that here in our own State of Pennsylvania we stand as one of the most progressive aeronautically of the forty-eight states. Five of the major airlines grace the borders and interior of our State.



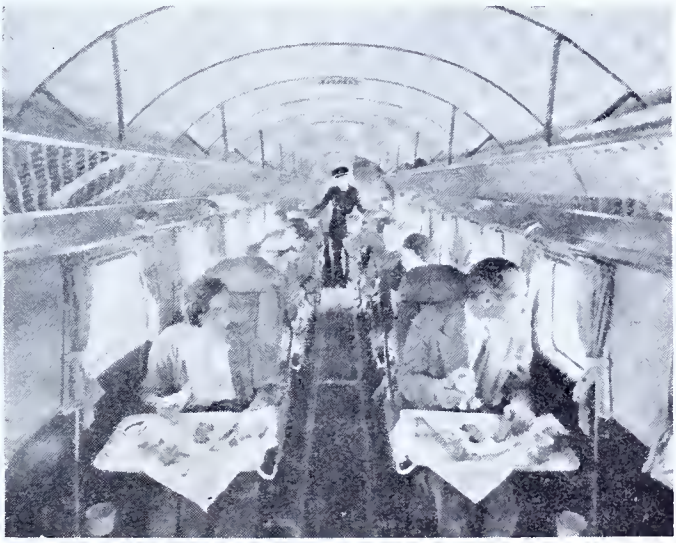
Airway map of the United States.



A graphic presentation of the progress made by airlines in reducing distances in the United States since 1931. (Courtesy of Unted Air Lines.)

Looking at the above picture one will very readily appreciate that United States seems to be shrinking, although this is not actually true from a standpoint of sealed distance, yet the great speed and advancement of airplanes and radio aids to air navigation has shortened the flying time from coast to coast.

It is suggested for an interesting study of the various towns shown along the routes of the major airlines that you stop at your nearest airport terminal and secure an airway map and air log, which sets forth very interestingly and through colored animation, a trip by air along the airways.



Sound proofed and equipped with 14 adjustable chairs the interior of this airliner offers the ultimate in comfort while traveling at 185 miles an hour. (Courtesy of the Eastern Air Lines.)

IV. MODERN AIRLINES

PLEASURABLE EXPERIENCES ON NATIONAL AIRLINES

Have you ever had a meal aloft or has some member of your family ever had a meal while flying through space at 185 miles an hour at various altitudes. If not, you have a real treat in store for you.

Travelers have stated that these meals have taken on a rare taste, especially the chicken and the bouillon and the soup were the best they have ever had served to them. Meals are served in the airliner on trays which are very securely fastened to the side of the seats. With the aid of stewards and hostesses, some have partaken of meals that could not be duplicated in some of the most expensive hotels in United States.

Eastern Airlines are one of the airlines operating in the United States that have men stewards instead of hostesses. You will note in the background of the picture there is a steward who is ready to serve and take care of every comfort and offer every convenience possible on your trip through the air.

Meals served aloft are one of the many conveniences offered to air travelers without any additional expense and are served at regular time during scheduled operations.

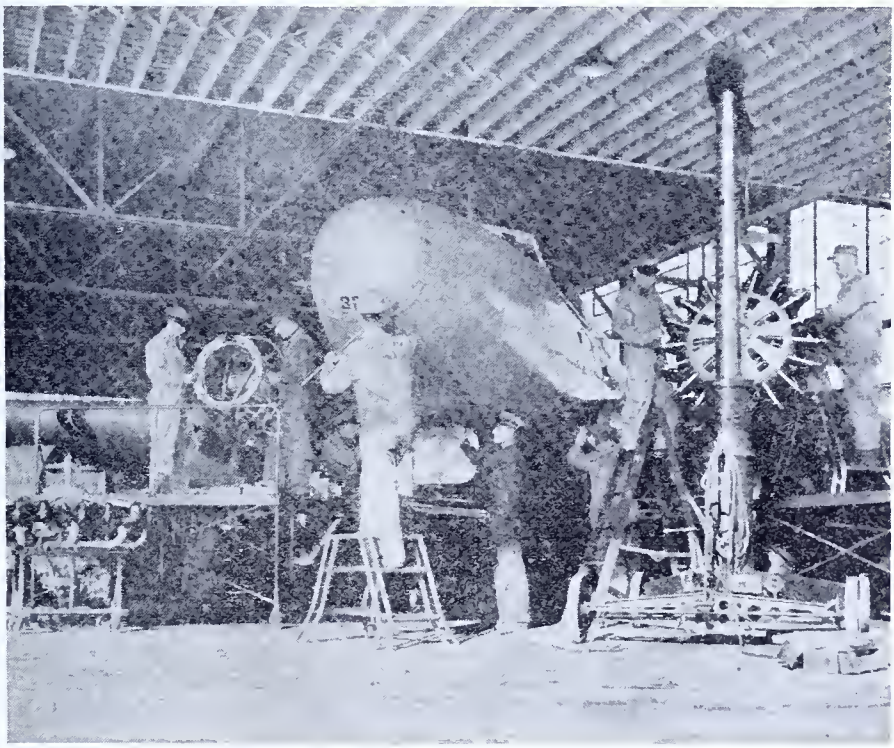
The carrying of air mail and express has become an important factor in air transportation, as the latest figures show. (Courtesy of Transcontinental & Western Air, Inc.)

Not only does the modern airliner make possible scheduled operations for the carrying of passengers on these routes, but also makes possible for the carrying of mail and express. Large compartments

for the carrying of mail are in the foremost part of the airplane directly back of the pilot's cabin and in the tail of the ship.

It is hoped that air mail rates may be sufficiently reduced to make possible the transmitting of all first-class mail as Air Mail. Most of the foreign countries today dispatch all first-class mail as Air Mail and it is hoped that this program may become possible in the United States. Although the airliners only stop at major terminals, and only a few of the more larger towns and cities in the United States are served by Air Mail, it is also hoped that in the very near future a system of feeder lines and shuttle lines will make possible the establishment of air mail service to every community.

Through a unique pick-up device today certain companies are making great strides toward the bringing of air mail service into practically every town in the State. This unique pick-up device makes it possible to pick up the mail while in flight and also to deliver pouches of mail without the necessity of the plane landing. If this program works out as it has been in the past, to some extent there will no doubt be a greater number of cities served with air mail and express facilities in the near future as the service becomes economically justifiable.



The airplane and aircraft engine mechanics shown here disassembling an airplane preliminary to general repair and overhaul are all trained men who either have Bureau of Air Commerce licenses or who work under men who hold such licenses. (Courtesy of United Air Lines.)

The following is a summary of interesting aviation information as of today: In the United States over 227 cities receive regular air transport service, and the following tabulations give a comparative list of pilots, mechanics and airports in the United States, as of January 1, 1939.

Pilot Certificates of Competency	22,813
Airline Pilot Certificates of Competency	1,161
Student Pilot Certificates Active	39,314
Glider Pilot Certificates of Competency	171
Student Glider Pilot Active Certificates	83
Active Mechanic Certificates of Competency	866
Parachute Riggers Certificates of Competency Active	397
Certificated Aircraft Active	721
Uncertificated Aircraft Active	1,161
Certificated Gliders Active	43
Uncertificated Gliders Active	177

In Pennsylvania we have over 118 fields and approximately 1000 pilots of various classification. In the United States there are approximately 2,374 fields of which 718 have various types of night landing equipment, also there are more than 11,000 airplanes.

CONCLUSION

This small treatise on aviation, from the standpoint of modern means of transportation, reveals the youth of the industry. However, it is equally plain that more rapid progress has been experienced in this phase of American life than in any similar enterprise.

The purpose of instruction in aeronautics is not only the development of skills, but the gaining of information leading to a better understanding and appreciation of this new American industry. While a study of aviation provides a background for many vocations in the field, its principal claim for a place in the public school program is in its contribution to the experiences and knowledge of general value to the pupils. For example, in the science departments of the public schools, such phases of aviation as air resistance, streamlining, gliding, stability, and construction of propellors are of distinct value in studying natural laws.

The students also learn a scientific approach to new problems by laboratory and experimental work in connection with the study of aviation. Their ingenuity, stimulated by the active interest of the teachers, makes it possible for them to construct such essential pieces of apparatus as wind tunnels, propellors, wings, and sextants. Their work thus proceeds with the aid of visual education in the form of models, specimens, graphs, charts, and even slides and motion pictures. The scientific approach to study is further encouraged by following a systematic procedure in these practical projects.

The social studies fields including history, civics, geography, economics, and law, may be greatly enriched through learning materials relating to aviation. The effects of this new service on civilization, international relations, foreign trade, and even government itself, are clearly related to the social studies program of the schools. The children and youth in the classrooms may learn something of the present need for men who have a knowledge of aviation; the qualifications required of one who seeks aviation as a career; the financial aspects of aviation service; the special laws required to govern and regulate this new enterprise in America, and the various types of planes, motors, airports, and other major features of aeronautical service.

Many of our young men will find jobs in aviation and closely affiliated industries. All accept aviation as the modern method of transportation. It, therefore, falls to the schools to not only keep children and youth up in their aviation, but to plan activities which look toward the preparation of youth for choosing careers in this industry, which is fast becoming a major factor in American life. In addition to the incidental information which they gather from conversation, observation, radio, and motion pictures, a systematic program of instruction may be developed from the use of current literature, particularly current books in the field of aviation.

Our public schools should accept as one of their responsibilities the task of selecting and providing abundant, authentic, and timely literature for the children and youth who are enrolled. Libraries may well make it a point to establish an aviation corner or section where collections of books and magazines in this vital field are constantly accessible to every child who may find it interesting to visit such a department.

BIBLIOGRAPHY

Civil Aeronautics Authority, Division of Publication and Statistics, Washington, D. C. Aeronautics pamphlet called Aeronautical Radio, Aeronautics pamphlet called Aviation Training. A pamphlet called Civil Aeronautics in United States and a pamphlet called the Federal Airways System, all of which can be secured free from the above department.

ARCTIC OCEAN
BEAUFORT SEA
BAFFIN BAY
GREENLAND
Davis Strait
HUDSON BAY
PACIFIC OCEAN
ATLANTIC OCEAN
Boston
New York
Philadelphia
Washington
Richmond
Charleston
Daytona Beach
St. Petersburg
New Orleans
Galveston
Brownsville
GULF OF MEXICO
Key West
Havana
CUBA
BAHAMA ISLANDS
Nassau
Tampico
Tuxpan
Veracruz
Belize
CARIBBEAN SEA
Barranquilla
Cartagena
Cristobal
CENTRAL AMERICA
Buenaventura
S. AMER.
AIRWAY MAP
North America
Scale of Miles

GULF OF MEXICO
WEST INDIES
CUBA
ATLANTIC OCEAN
CARIBBEAN SEA
CENTRAL AMERICA
VENEZUELA
GUIANA
COLOMBIA
ECUADOR
PACIFIC OCEAN
SOUTH AMERICA
BRAZIL
BOLIVIA
PARAGUAY
URUGUAY
ATLANTIC OCEAN
AIRWAY MAP
South America
Scale of Miles

Africa - Asia
and
Australia
AUSTRALIA
INDIAN OCEAN
ATLANTIC OCEAN
ATLANTIC OCEAN
PACIFIC OCEAN
EAST INDIES
ARABIAN SEA
RED SEA
SAUDI ARABIA
LIBYA
FRENCH WEST AFRICA
BELGIAN CONGO
SUDAN
TASMAN SEA